SCIENCE.

FRIDAY, JUNE 21, 1895.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison on Hudson, N. Y.
Subscriptions and advertisements should be sent to SCIENCE, 41 N. Queen St., Lancaster, Pa., or 41 East 49th St., New York.

ON THE DISTRIBUTION AND THE SECULAR VARIATION OF TERRESTRIAL MAGNETISM.

IN two papers* read before the Philosophical Society of Washington, May 25th, the following main results were obtained:

*'On the Secular Variation of Terrestrial Magnetism' and 'A Preliminary Analysis of the Problem of Terrestrial Magnetism and its Variations.'

The minimum change in declination along a parallel of latitude at any particular time, and the minimum average secular change along a parallel of latitude during a given interval of time occur near the equator; both quantities generally increase on leaving the equator.

Exactly the reverse is the case with regard to the inclination, viz.:—

The maximum change in inclination along a parallel of latitude at any particular time, and the maximum average secular change along a parallel of latitude during a given interval of time occur near the equator; both quantities generally diminish on leaving the equator.

These laws were established with the aid of data scaled from magnetic charts from 1780 to 1885 at points 20° distant in longitude and in latitudes 60°N, 40°N, 20°N, equator, 20°S, 40°S and 60°S. They again point to the same conclusion reached previously by the writer in a somewhat different way, namely, *that the distribution and the secular variation of terrestrial magnetism appear to be closely related; they are subject to similar laws. It is hence probable that they are both to be referred primarily to the same cause. This common cause seems to be connected in some way with the earth's rotation.*

If we regard the earth as uniformly magnetized, having its magnetic poles coincident with the geographical poles, and take the X axis of a system of coördinates whose origin is in the center of the earth, parallel to the magnetic axis, we shall get the fol-

lowing expression for the potential function at any external point, viz.:

$$\psi = \tfrac{4}{3}\,\pi\,\mu\,a^3.\,\frac{x}{r^3}$$

a is the mean radius of the earth, r the distance of the point from the origin, and μ the intensity of magnetization per unit of volume.

For points on the earth's surface, this reduces to:

$$\frac{\psi}{a} = \psi_a = \tfrac{4}{3}\,\pi\,\mu.\,\sin\phi = c.\,\sin\phi \qquad (1)$$

φ is the geographical latitude and $c = \tfrac{4}{3}\,\pi\,\mu$.

This formula is doubly interesting just now, as it has been recently deduced empirically by Professor W. von Bezold.* This eminent investigator, when considering the mean values of the geomagnetic potential along parallels of latitude, found them subject to the simple law $\psi_a = c.\,\sin\phi = 0.330\,\sin\phi$. Since $c = \tfrac{4}{3}\,\pi\,\mu$, and the magnetic moment, M, of the earth is equal to $\tfrac{4}{3}\,\pi\,\mu.\,a^3$, we find that von Bezold's empirical coefficient implies a value of the magnetic moment equal to 8.52×10^{25} against 8.55×10^{25} as determined by Gauss. We thus see the theoretical significance of von Bezold's factor.

Since for the case supposed the horizontal component of the intensity, H, is directed meridionally, it follows from (1) that:

$$H = \frac{\delta\psi}{a\,\delta\phi} = c.\,\cos\phi \qquad (2)$$

Furthermore, with the aid of simple transformations:

$$V = 2\,c.\,\sin\phi \qquad (3)$$

$$F = c.\,\sqrt{3\,\sin^2\phi + 1} \qquad (4)$$

$$\tan I = 2\,\tan\phi \qquad (5)$$

V being the vertical force, F, the total and I, the inclination. Formulæ (2), (3), (4) and (5) are familiar to every nautical geomagnetician.

* See his admirable paper 'Über Isanomalen des erdmagnetischen Potentials,' Sitz. berichte d. Kgl. Preuss. Akad. d. Wiss. zu Berlin. Phys.-math. Classe, April 4, 1895.

Now the writer finds that these formulæ give the mean values of the magnetic elements along parallels of latitude with a high degree of precision. As this paper will be printed in full in the *American Journal of Science* beginning with the August number, I will select but one typical example.

1885.

Latitude	I obs'd *	I Comp'd	O.–C.
60° N	74°.9 N	73°.9 N	+ 1°.0
40°	59 .7 N	59 .2 N	+ 0 .5
20°	34 .3 N	36 .1 N	— 1 .8
Equator	3 .2 S	0 .0	— 3 .2
20°	36 .8 S	36 .1 S	— 0 .7
40°	57 .2 S	59 .2 S	+ 2 .0
60° S	70 .2 S	73 .9 S	+ 3 .7

Since, according to equation (2).

$$c = \tfrac{4}{3}\,\pi\,\mu = \frac{M}{a^3} = H.\,\sec\phi \qquad (6).$$

we can get a fair value of the magnetic moment of the earth without the aid of the laborious Gaussian computation by simply scaling the value of H for equidistant points along a parallel of latitude from isodynamic charts and substituting the mean of the values thus found in (6).

Thus I get for 1885 as the mean result of the scalings along 40° N, 20° N, Equator, 20° S and 40° S, the value of $0.325\,a^3$ for M, against $0.322\,a^3$ resulting from the 1885 Neumayer-Petersen re-computation of the Gaussian co-efficients.

But why should the values obtained on the assumption that the earth is uniformly magnetized, and its magnetic axis coincident with the geographical axis, so nearly agree with those based upon observed quantities? It seems to me that this opens the question whether the asymmetrical distribution of land and water is the primary cause of the asymmetrical distribution of telluric magnetism, as generally supposed. Why do the 'anomalies' in the distribution so nearly cancel each other in going along a parallel of lati-

* These quantities are the results of the scalings of Neumayer's charts for the points mentioned.

tude? Does this again imply that the rotation of the magnetic earth is an important factor?

If we connect by lines all the places on the earth's surface having the same departure (with due regard to sign) from the values as computed from above formulæ we get a series of curves that converge around two foci of maximum and minimum departures. I have carried out this idea with the aid of my collected data in the case of the inclination for three epochs, 1780, 1880 and 1885. I call the curves thus obtained lines of equal departing inclination, or, briefly, 'isapoclinics.' It is especially remarkable that these lines close around two points not on *opposite* sides of the equator, but on the *same* side.* Their preliminary positions are:

	Latitude.	Longitude.
For 1885.		
North end attracting focus,	20°S.	40°W of Gr.
South end attracting focus,	5°S.	40°E of Gr.
For 1780.		
N. F.	0°	50°W.
S. F.	0°	60°E.

These positions are subject to a slight revision. The main part, however, is brought out very clearly in both cases, viz.: *that the chief cause of distortion of the primary symmetrical field can be represented as due to a secondary polarization approximately equatorial in direction.*

I then showed that the isapoclinics obey in a remarkable degree the laws governing a magnetic system. They do not run at random. Thus, for example, the foci or poles of this secondary system fall nearly on the agonic lines of the actually observed field, and the secondary magnetic equator running roughly north and south marks out approximately the places where occurs the maximum declination. *In a word, the magnetic field which we actually observe can be nearly obtained by super-imposing a secondary equatorial field upon a primary polar one.*

By comparing the maximum horizontal intensities of the the two systems, as found in the respective magnetic equators, I find that the *polar field is about five to six times stronger than the secondary, and that the axis of the resultant system would make an angle of about 10° with the rotation axis.*

Furthermore, the secular variation phenomena can be qualitatively explained by the shifting of just two such poles as belong to the secondary system. It cannot be explained by the disturbance of poles on *opposite* sides of the equator.

We should thus have to refer both the distribution and the secular variation to apparently the same kind of a polarization.

This harmonizes with the empirical conclusions at the beginning of this paper.

Since the intersection of the agonic lines with the equator fall so nearly together with the positions of the isapoclinic foci, a fair idea, perhaps, can be obtained of the shifting of these foci from the motion of the agonic lines along the equator. I find that both agonic lines have been moving westwardly along the equator for the last 300 years at the average rate of about 0.°2 per annum. If the motion continues around the equator at this rate the resulting period would be about 2000 years, but I do not wish to be understood as asserting that this is the secular variation period.

A possible third field, which has been made probable by Dr. A. Schmidt's beautiful researches, was also pointed out. Schmidt found, namely, that not the entire observed magnetic effect on the earth can be referred to a potential; currents that *pierce* the earth's surface seem to make themselves felt. Perhaps his currents can be explained thus: If an arbitrarily magnetized sphere rotates in a conducting fluid,

*Similar results have been obtained by von Bezold in the paper cited, and by A. von Tillo as seen in his preliminary paper in Comptes Rendus, Oct. 8, '94, pp. 597–599. It is very much to be hoped that von Tillo's charts will soon be published.

the surface of contact of sphere and fluid being conducting, currents will be incited in the fluid that will pass into the sphere and out again.

In the case of the earth there is no fluid with reference to which the solid earth performs a *total* differential rotation; still there are *partial* differential rotations due to moving streams, ocean currents, tidal waves and air currents. Such a field, if it exist, can be differentiated with the aid of the potential theory.

Purely local disturbances would constitute a fourth—the 'anomalous field.'

We as yet have no satisfactory answer as to the *origin* of the earth's primary magnetic field, neither has the astronomer an answer to the query 'Whence the moon.' He, however, accepts the moon's existence and computes its disturbing effects upon the earth's motions. Just so it is with the earth's magnetism. We do not know whence it has come, but we know it is there. We know that to-day the magnetic earth is rotating about an eccentric axis, and so let us ask ourselves *What is the effect of the self-inductive action of the rotating magnetic earth? How is the principle of the conservation of energy when applied to the motions of the magnetic earth to be fulfilled?*

L. A. Bauer.

ON A DEVONIAN LIMESTONE-BRECCIA IN SOUTHWESTERN MISSOURI.

The brecciated limestone which it is proposed to describe in this paper outcrops near the base of Eagle Ridge, on the west side of the valley of Dry Creek, five miles west of the town of Galena, county seat of Stone County, Missouri. The several members of the Devonian strata in this portion of the State are, in their normal condition, very regular and evenly bedded, and are perfectly conformable, from their base, to and with the overlying Kinderhook Group. They rest, with slight local unconformity, on the magnesian limestones of the Ozark Series, and then out toward the east, at the expense of the lower members, each stratum overlapping that which is under it. In the vicinity of the limestone breccia they present the following sections: 1. Green Shale, 7 feet. 2. Shaley Limestone, 10 feet. 3. Speckled Crinoidal Limestone, 3 feet. 4. Basal Conglomeratic Sandstone, 4 inches.

Proceeding south along the west side of the valley we find the first indication of a disturbance in the form of a gentle undulation of the upper portion of the shaley limestone, No. 2 of the section. A few hundred yards further we encounter the first of a series of huge masses of breccia, consisting of the light gray, amorphous limestone and thin shale of No. 2, broken into angular fragments of various sizes, and recemented, partly by a similar substance, and partly by the subsequent infiltration of calcareous matter occurring now in the form of calcite. The original bedding planes have been mostly obliterated, and the breccia weathers out along the hillside in boulder-like masses, 10 to 20 feet thick, and 50 to 100 feet in width. A stratum of shaley limestone at the base of these masses partially retains its original appearance, and from its relation to the more massive breccia overlying it the whole is seen to have been subjected to violent contortion and fracture, such that boulders of hard limestone have been forced into the midst of calcareous shale. There are about half a dozen of these masses exposed along the valley side, in a distance of about 1000 feet; then the undulations decrease, and at one-half mile from where the first disturbance in the strata was noticed they entirely cease, and from thence down the valley the strata are in their normal condition.

There is no indication of the action of water in the formation of the breccia. All the fragments are sharply angular, and frequently a fossil has been broken through

and the positions of the pieces slightly changed, but not widely separated as they would inevitably have been had the brecciated masses been accumulated by wave action on a seashore. The hypothesis that the brecciation and contortion were produced by undermining of the strata and by subsequent crushing from the weight of the superincumbent rock is inconsistent with the facts. The lower members of the Devonian strata are undisturbed, and in the central portion even the whole of No. 2 seems to be present and perfectly horizontal and the breccia rests on it increasing the thickness of the Devonian strata from its normal 20 feet to 40 feet in the central portion of the disturbance.

In short, the only theory which will explain all the phenomena is that which has been applied, in explanation of the manner of formation of similar but vastly more extended Devonian limestone breccias in Iowa, viz., by lateral pressure produced by the 'creep' or sliding on a sloping sea bottom of the displaced strata immediately after their deposition.

From a study of the strike of the undulations, displacements and other attendant phenomena, it becomes evident that the pressure was applied from the northeast. The Devonian strata at present rise in that direction at a rate not exceeding 8 or 10 feet per mile, and during the Devonian age were doubtless still more nearly horizontal. It is remarkable that so slight a slope could have given rise to a sliding of a portion of the sea bottom, but it is undoubtedly the fact that, while the deposition of the Devonian strata had proceeded without interruption to the top of the shaley limestone No. 2, the upper 2 or 3 feet began to slide on the underlying stratum. About the western line of Stone county the resistance overcame the weight of the 'creeping' strata, and the tension becoming too strong, at one place certainly and perhaps at others not yet discovered, that they suddenly gave way, were contorted, brecciated, forced forward and hurled in boulder-like masses on to other undisturbed strata.

Considering the intensity of the force and the conditions under which it was applied, it is surprising that the area of the disturbance should be so small; on the opposite side of the valley, one-eighth of a mile distant, there is not the slightest sign of it, and in the next valley, one-fourth of a mile southwest from it, the Devonian strata are undisturbed. Its areal extent cannot be greater than one-fourth square mile.

The lithification of the shaley limestone was practically complete at the time of the displacement, for the fragments are all sharply angular and must then have been very hard. And as the relation of the overlying strata shows that the period of the disturbance immediately succeeded that of deposition of No. 2, deposition and lithification must have proceeded contemporaneously.

The green shale, which is the upper member of the Devonian in this region, thins out in the hollows between the dome-shaped prominences of the surface of the breccia, and totally disappears over the higher portions of the disturbed area. The points where it is absent are not now and never were more than twenty feet higher than the surrounding sea bottom, where the green shale was deposited in very regular laminæ, without wave action. The areal distribution of the green shale is such as to show that it was deposited in a comparatively small and shallow esturine basin, connecting with the sea toward the south, and supplied with fine sediment from the land on the east and north. The limited extent of this body of water accounts for the feebleness of its waves, which did not affect the green shale at the depth of only twenty feet around the elevated area formed by the breccia. The higher prominences

of the breccia were slightly eroded by wave action during the deposition of the green shale in the surrounding water, but the leveling had not proceeded far when the Devonian age came to a close; the entire region was depressed, and the Louisiana limestone (formerly known as the Lithographic limestone), or basal member of the Kinderhook Group, was laid down over the breccia. It is usually a regularly bedded, dark gray limestone, everywhere perfectly conformable to the green shale, but over the distributed area it is irregularly bedded and slightly arched, but soon succeeded, by thickening in the hollows and thinning over the prominences, in leveling off the ancient sea bottom. The Lower Carboniferous strata are here locally unconformable with the Devonian. We have thus seen that the thinning of the green shale over the area of disturbance fixes the time of said disturbance at the period between the deposition of Nos. 1 and 2 or the shaley limestone and the green shale. From a general resemblance between the shaley limestone of this region and portions of the Cedar valley limestone of Iowa, and from the fact that this peculiar mode of brecciation obtained in both regions, I wish to suggest that the light brown or gray, amorphous, shaley limestone of southwestern Missouri may be the equivalent of the Cedar valley limestone of central Iowa.

Oscar H. Hershey.

Galena, Mo.

CURRENT NOTES ON PHYSIOGRAPHY (X.)

LEY'S CLOUDLAND.

This long expected work (Stanford, London, 1894. 208 p.) is an effort to establish a classification and terminology of clouds on a genetic basis. While such a plan has much to commend it, and must eventually be adopted in fully developed form, its presentation now is perhaps premature; for there is yet much to learn regarding the origin of certain cloud forms, and much difference of opinion still prevails on the subject. Four chief classes are recognized in Ley's scheme: clouds of radiation, such as ground fogs; of inversion, such as cumulus, dependent on overturnings in an unstable atmosphere; of interfret, such as waving stratiform clouds formed at the contact of layers of different temperature; and of inclination, such as pendent cirrus wisps, caused by the settlement of particles from one atmospheric stratum into another. The illustrations, reproduced from photographs by Clayden, are for the most part excellent. The chief deficiency of the work is the absence of comparative tables, by which the terms proposed by Ley may be translated into those adopted by the International Meteorological Congress. In a number of passages exceptions must be taken to the manner of physical explanation of cloud formation, especially to statements concerning the relation of water and ice particles in cumulus and cirrus clouds, and to the repeated implication that the liberation of latent heat in the condensation of vapor actually warms the air. The chapters on the theory of atmospheric currents and on the prevailing winds of the globe are hardly relevant to the rest of the book and add little value to it. Remembering that the author has devoted years of observation to cloud study, and that latterly his work has been much interrupted by ill health, it is doubly a regret that his book cannot be more highly commended.

BUREAU CENTRAL MÉTÉOROLOGIQUE.

The latest series of *Annales* of this important Bureau contain as usual a volume of memoirs in which, besides the statistical studies of thunder storms in France by Fron and several reports of magnetism, there are essays by Angot on the advance of vegetation and the migration of birds in France for ten years, 1881–1890, and on the meteor-

ological observations on the Eiffel tower during 1892; and by Durand-Gréville on squalls and thunderstorms. Nearly all the features of the advance of vegetation exhibit the accelerating influence of the Mediterranean and the retarding influence of the Bay of Biscay. The records of the Eiffel tower are chiefly interesting in showing inversions of nocturnal temperature in the means of all the months, and consequently in proving a distinct variation in the diurnal values of the vertical temperature gradient in the lower atmosphere; as well as a change of the time of maximum wind velocity from afternoon at surface stations to night at the top of the tower. Durand-Gréville's essay is illustrated by an excellent chart of the distribution of pressure during an extended squall that occurred on August 27, 1890; the isobars being drawn for every millimeter, and showing a sharp N-like double bend at the place of the squall.

WINTER STORMS IN THE NORTH SEA.

THE famous Christmas storm of 1821, which led Brandes and Dove to their early statements concerning the system of storm winds, finds a modern parallel in a storm of December 22–23, 1894, described by Köppen in the *Annalen der Hydrographie*, edited by the Naval Observatory at Hamburg, and published in Berlin. On the morning of December 22 the storm center, with a pressure of 715 mm., lay just east of Scotland; on the evening, with a pressure of 725, the center lay just west of Denmark. The whirling courses of the winds are well illustrated; a southerly gale crossed the Baltic, while a northerly gale raged on the North sea; violent east winds blew off the coast of Norway, and westerly gales were recorded in northern Germany. Disastrous storm floods were felt at many points on the coast, and salty rain fell at many points in England. Other storms were felt a week earlier and later; but, apropos of this apparent periodicity, Köppen remarks that thus far all efforts to establish weekly, monthly or longer weather cycles have, without exception, failed, and that, while the faint and easily obliterated traces of such periods have a certain scientific interest, they have not yet a practical value. The *Annalen der Hydrographie* is a characteristic German journal, in which a serious and scientific style of work is carried into the accounts of foreign coasts and harbors, as reported by officers of the marine. It frequently contains articles and reviews of interest on winds, tides and currents.

ELEVATION AS A CAUSE OF GLACIATION.

IT is probable that no one questions the sufficiency of elevation to account for glaciation, if other things, such as external controls of climate, remain unchanged; but there are serious difficulties in the way of accepting the thesis maintained by Upham (latest expressed in Bull. Geol. Soc. Amer., vi., 1895, 343–352) to the effect that the glacial sheets of northeastern America and northwestern Europe were caused by and hence were coincident in time with the elevation that permitted the erosion of the deep marginal valleys of the continents. Upham cites the case of the Sogne fiord, on the west coast of Norway with a maximum sounding of 4,080 feet, as a measure of the epirogenic uplift which at its culmination caused the glaciation of northern Europe. The difficulty here is that while a comparatively long period of elevation must be postulated for the excavation of the valley of Sogne fiord, and while climatic change would respond immediately to elevation, yet glacial conditions are not known to have occured until the erosive effects of elevation were practically completed. The steepness of the fiord walls indicates that the elevation was not slowly progressive, but was rather promptly completed and steadily maintained; being in this unlike

the elevation by which the erosion of the flaring and benched valleys of the northern Alps has been allowed. The problem involved in the relation of elevation and glaciation would therefore seem to be not the simple one of immediate cause and effect, but on the other hand the difficult one of why the apparently competent cause should not have at once had its expected effect; why glaciation should have waited so long after elevation, not attaining its maximum until a time of depression.

FORESTS AND TORRENTS.

THE much-debated problem of the influence of forests on rainfall remains unproved, after all that has been said and done; but the influence of forests on torrents admits of no question. The soil is washed from the deforested slopes and the torrents spread it over the valleys, greatly to the injury of both high and low land. The Shenandoah Valley, for example, one of the most beautiful and productive farming districts in our country, is suffering along its margin from the encroachments of gravels and sands washed from the enclosing deforested ridges. Those who wish to present this matter to forestry meetings in popular and impressive form will find an abundance of illustrative material with references to European literature on the subject in an essay by Toula: *Ueber Wildbach-Verheerungen and die Mittel ihnen vorzubeugen* (Schr. Vereins zur Verbreitung naturw. Kenntnisse in Wien, xxxii., 1892, 499–622, with forty-one views from photographs). W. M. DAVIS.

HARVARD UNIVERSITY.

NOTES ON AGRICULTURE (III.)

THE EXPERIMENT STATION RECORD.

THE Experiment Station Record, a monthly (practically) published from the office of Experiment Stations of the U. S. Department of Agriculture gives under the heads of Chemistry, Botany, Zoölogy, Meteorology, Soils, Fertilizers, Field crops, Horticulture, Forestry, Seeds, Weeds, Diseases of Plants, Entomology, Foods, Veterinary Science, Dairying, Technology, Statistics and Miscellaneous, the progress made in these various branches in the Experiment Stations of our country. The recent work in Agricultural Science in foreign countries is also briefly summarized.

From the last issue of the Record, just received, the reader is first of all informed as to the amounts of the appropriations made by Congress for the U. S. Department of Agriculture for the year ending June 30, 1896. The total amount is $2,578,750, which includes $720,000 for the Experiment Stations established under the act of Congress of March 2, 1887. There will be two new divisions in the U. S. Division of Agriculture, namely, that of Agrostology, which contemplates 'field and laboratory investigation relating to the natural history, geographical distribution and use of the various grasses and forage plants,' and that of Soils.

Among reports of agricultural science in foreign lands is a paper upon 'Agricultural Investigations in Switzerland,' by Dr. Grete, director of the Swiss Station at Zurich. In 1878 a Station for control of fertilizers and feeding stuffs was established, and recently its work has been extended to include culture tests of soils. There is a Seed Control Station which at the present time has eight workers besides the director, and tests by germination thousands of samples of seeds.

Under the head of chemistry the Record gives the new methods of obtaining solutions in soil analyses and the determination of phosphoric acid. The department of Botany contains a review of Professor Scribner's 'Grasses' of Tennessee, which is a valuable contribution to the Agrostology of the whole country. 'Notes on Maize,' by Dr. Sturtevant, contains generalizations upon the

effect of climate upon corn, the view being maintained that northern grown varieties are not necessarily earlier than southern sorts. The popping of corn is due to the starch lying within a tough layer which bursts upon the application of heat.

Under meteorology winds injurious to crops are considered at length in a digest of Mr. Curtis' bulletin. Three classes of destructive winds are considered, namely, violent, cold and drying winds. Of the cold winds there are two classes, the mountain and valley, and those associated with cyclones, the so-called blizzards and 'northers,' chiefly destructive to orchard crops. The extent of the latter has increased with the progress of deforestation, and the Michigan peach belt, with its failures in late years, is given as an example. Under 'Variations in the Character of the Seasons,' Mr. Gawthrop shows cause and makes an appeal for the exploration of the upper atmosphere. Mr. Clayton, under 'Rhythm in the Weather,' claims that 'there is good reason to believe that through all this seeming irregularity there runs a web of harmony and rhythm,' and expects that meteorology will in time become an exact science. It is certainly gratifying to note how much attention is being given to the weather and the progress that is made from year to year in its study.

While the air is being investigated the soils are not neglected. In addition to analyses in relation to fertilizers the action of organic acids is reported upon by H. Snyder, of the Minnesota Station. Soil temperatures are taken at many Stations and facts are rapidly accumulated upon soil meteorology as well as the movements of liquids and gases in the soil.

Naturally, a large part of the chemical work of the Experiment Stations is with fertilizers and the record before us gives a full share of its space to this branch of the Station service. The New Jersey Station issues a large bulletin giving the results of analyses, while the Maine Station reports upon the foraging powers of some agricultural plants for phosphoric acid, as tested by box experiments. The Louisiana Station issues a large bulletin upon the 'Results of five years' experiments with fertilizers.' This is not the place to give conclusions, the point here being for the readers of SCIENCE to realize that experiment work in this country is widespread in the broad sense, and that we are entering an age that has for its watchword, 'Prove all things,' while we may hope that we hold fast to that which is good.

Mr. Crazier, of Michigan, takes up a single somewhat obscure crop, the millet, and with sixty-four pages of text and six figures gives results obtained from seventy-three samples grown under varying conditions. In like manner Mr. Hilgard, of California, brings out the facts concerning the new tannin-producing plant carnaigre. From the same Station is a bulletin upon the Australian salt bush, which grown upon 'some of the most alkali spots yielded at the rate of five tons of dry matter per acre,' and is eaten with relish by live stock. Experiments upon wheat, tobacco, potatoes and several other standard crops receive notice in the Record.

Under Horticulture Mr. Heideman, of the Minnesota Station, gives a 'classification of the sexual affinities of Prunus Americana vars. Numerous crosses were made between the various forms of flowers, most of which were not hermaphroditic, and out of forty-nine possible combinations of pollination only 13 were legitimate. Mr. Lodeman, of Cornell, has issued a bulletin upon 'grafting of grapes,' illustrating directions for the various methods and remarking upon the physiology of the process. In his annual report, Mr. Munson, of Maine, gives notes upon various crops. Thus in a cross between ignotum and peach tomatoes there was 'a marked falling off in the second generation over the advantage indicated by the first.'

Mr. Buckhout after 'five years' experience in planting forest trees' concludes in the Pennsylvania Station Report "that considering the time, expense and work involved, artificial forest planting cannot be recommended, at least in the way pursued in the experiment and that natural methods of reforesting supplemented by some seed sowing, thinning and planting will suffice for the present." Mr. McCarthy, of the North Carolina Station, has prepared a bulletin upon seed testing and fully describes its uses and methods. Weeds receive attention from Mr. Wooton, of the New Mexico Station, who figures several of the worst in his Territory.

Under diseases of plants some grape troubles in New York are reported upon by Mr. Lodeman of Cornell. Thus the so-called 'shelling' is ascribed to one or more of four causes, namely, parasites, conditions of vine, of soil, or of atmosphere. An English experimenter shows that finely ground lime 700 pounds per acre will check the club root in turnips. Resin is found by Mr. Webber to be effective in preventing the sooty mould of the orange.

Economic entomology receives consideration under many heads as the damage caused by American locusts, chinch bugs, codling moth, etc. A new saw-fly and pear insect are mentioned and many species are named under beneficial insects. Gas treatment for destroying scale insects is reported upon from California and 'Entomology and Quarantine' is considered.

Much space is given to the consideration of foodstuffs, their analyses, digestibility, etc., the Maine Station perhaps taking the lead in these matters in the copy of the Record in hand, while Utah and Minnesota come in for a share in 'dairy herd records' and 'relative value of corn and oats for horses.' Several papers are mentioned by title or at length under dairying.

Surely enough has been here given to show that the Experiment Stations of the United States are pushing on along many lines, and that through the facts accumulated principles cannot but be laid bare.

THE HORTICULTURALISTS' RULE-BOOK.

The first edition of this 'compendium of useful information for fruit-growers, truck-growers, florists and others' by Professor L. H. Bailey, of Cornell University, was published in 1889 and a second in 1892. The great advances made in methods of combating insect and fungous enemies during the past few years led the author to revise and extend his work. A chapter upon greenhouse heating has been added and another upon the current literature of horticulture.

The following are some of the leading subjects considered: insecticides and injurious insects, plant diseases with preventives and remedies; injuries from mice, rabbits and other animals; weeds, seed-tables, etc. There is a chapter upon *Rules* in which are given rules for naming fruit, codes of various societies, etc. Within the flexible covers of this little book the publishers (Macmillan & Co.) have neatly packed together a surprising amount of valuable information. Here the horticulturist may learn how much seed to sow per acre, how many plants to set in his orchard, how to keep off the enemies to his crop, and when to harvest and market it. Not the least is a list of the leading books that have been published upon horticultural subjects and within easy reach of crop growers.

Byron D. Halsted.

CORRESPONDENCE.

THE ILLUSTRATIONS IN THE STANDARD NATURAL HISTORY.

To the Editor of Science—*Sir:* Referring to the statement in Science of April 5, 1895, page 387, top of second column, that certain illustrations of Brehm's *Thierleben*

'were pirated by the *Standard Natural History*,' I beg to say that it is incorrect and libelous. The matter concerns me, as one of the authors of the *Standard Natural History*, and also as the author of the *Key to North American Birds*, in several later editions of which many of the same illustrations were used by my publishers, Messrs. Estes & Lauriat, of Boston. As 'piracy,' like plagiarism, implies dishonesty, the allegation thus made by Dr. C. Hart Merriam, who signs the article, is too serious to be overlooked.

Nevertheless, being ready to believe that Dr. Merriam erred through inadvertence, I am prepared to accept an apology, in so far as I am personally concerned; but I am not authorized to state that this will be considered satisfactory by the other parties who have been thus libeled.

Very truly yours,
ELLIOTT COUES.

WASHINGTON, D. C., June 5, 1895.

[The word piracy may be used in two senses—moral and commercial. When I wrote the article in which it was stated incidentally that the Brehm plates in the *Standard Natural History* were pirated, I believed that they were in both senses. Among the reasons for this belief may be mentioned the following:

1. The book itself contains no statement of the fact that the illustrations are taken from Brehm.

2. The anatomist Fürbringer states that he searched in vain for a copy of the *Standard Natural History* in Germany (Journal für Ornithologie, Apr., 1892, 138).

3. It is stated in the *Naturæ Novitates*, Berlin (Vol XV., No. 1, Jan., 1893, p. 18, nr. 326), that the work 'may not be imported into Europe on account of the reproduction of the Brehm woodcuts.' ['Darf in Europa wegen Nachdruck der Brehmschen Holzschnitte nicht eingeführt werden.']

4. The name of the artist, Mützel, was erased from many of the copied plates. When the attention of the editor was called to this injustice, he replied: "The cutting out of Mützel's name was a business necessity."!

If, in spite of the above facts, the cuts in question were sold to the publishers of the *Standard Natural History* by the publishers of Brehm's *Thierleben*, I withdraw so much of my original charge as may be inferred to imply commercial piracy; but I by no meams retract the charge of moral piracy—the greater offense of the two, because it has no legal redress.

Is the deliberate reproduction of another's pictures without credit less censurable than the reproduction of another's words or ideas? And what shall one say when the sin of plagiarism is darkened by the erasure of the artist's name, so that neither artist nor author may be known?

Just why Dr. Coues mentioned his *Key to North American Birds*, and his publishers, Estes & Lauriat, who by the way were not the publishers of the *Standard Natural History*, is hard to understand, inasmuch as neither were mentioned in the review to which he takes exception.

Since the above note was sent to SCIENCE I have received a letter from the publishers of Brehm's *Thierleben* in Leipsic. They state that they sold to Estes & Lauriat certain electrotypes from Brehm, to be used by Estes & Lauriat only, 'under an agreement according to which it was forbidden to Messrs. Estes & Lauriat to resell these electrotypes.' They state further: "As we had been informed that notwithstanding this settlement our electrotypes had been resold, we called Messrs. Estes & Lauriat to account, and they were forced to confess that they had resold the electrotypes" to three different firms!

In reply to my question: "Were the electrotypes sold by you to S. E. Cassino & Co., and published in the *Standard Natural*

History with your knowledge and consent," they state: "We answer No! These electrotypes had *not* been sold by us to Messrs. S. E. Cassino & Co., and were used without our permission in the said works. Besides, we are still at issue with Messrs. Estes & Lauriat, Boston, on account of this affair."

C. Hart Merriam.]

SCIENTIFIC LITERATURE.

Report on Water Supply; Geological Survey of New Jersey. By Cornelius Clarkson Vermeule, Consulting Engineer. Vol. III. of the Final Report of the State Geologist. 1894.

The Geological Survey of New Jersey has just issued a report bearing the above title, the interest and value of which are not limited by State lines. Its author, under whose direction the topographic map of the State was made, has had the best of opportunities for studying the questions involved, and has not failed to avail himself of them. The results of his study have been put in as simple and available form as possible, considering the complex nature of the problems.

The range of interests touched by the report is great. It will be of inestimable value to cities and communities which draw or may draw their supply of water from the streams of the State, and to manufacturers who use or may use the power afforded by them. Less directly, but not less certainly, the report will be of great value in the same lines outside the State, since many of the principles developed are of general and some of them of universal application. The report also contains discussions and suggestions which have a bearing on agriculture and forestry, the latter of which is just now attracting wide attention in this and other States. The educational value of the report is great, not only to those whose financial and sanitary interest are touched by it, but also to students of hydrography and geology, and to intelligent citizens in general. From this standpoint, its value lies not only in what it proves and affirms, but also in what it disproves and denies. It is scarcely too much to say that there is not a community or a class in the State which may not be benefited by the intelligent study of the volume before us.

The study of the water resources of the State was begun by Professor Cook long ago. As early as 1868 the subject was discussed by him, and the annual reports of the State Geologist have since made frequent reference to the subject, and have reported the progress of the work, the results of which are now embodied in this volume. Interest in the questions of which it treats has been stimulated by the rapid growth in population, especially in the vicinity of New York and Philadelphia. In 1882, 587,760 people in New Jersey were dependent for water upon systems of public supply. In 1894 this number had nearly doubled, while the amount of daily consumption had increased from about 49,000,000 gallons to about 108,000,000. Of this amount, 100,000,000 gallons were drawn from streams. If the population of the State continues to increase at the present rate for another half century, and if the demand for water keeps pace with the increase in population, as is sure to be the case, it is evident that another half century will make heavy demands upon the available supply of water which the State affords. On the basis of the recent rate of increase in population, it is estimated that by 1950 that part of New Jersey adjacent to New York City will need 547,000,000 gallons of water daily; and the author remarks that "since fifty years cannot be considered a long time in the future for which to make provision, it is evident that the time has come for us to know what our resources are and to provide for their preservation and wise development" (p. 6).

The investigation of the water resources

of the State has involved a careful study of the relation between precipitation and stream flow. This study has led to some very important conclusions, the data for which are drawn not merely from within the State of New Jersey, but from all available sources. The analysis of the facts has led Mr. Vermeule to the conclusion that a formula may be adopted which shall express with approximate accuracy the relation between rainfall and evaporation, within the basins of the streams studied. This formula is E=15.50+.16 R, in which E= total annual evaporation, R= annual precipitation, and 15.50 stand for inches of water. R minus E will equal the annual flow of the river in question. A modification of the formula for mean annual temperature is suggested, and in this modified form it becomes universal. In this connection it is stated that a careful study of the annual precipitation and flow of variously widely separated streams "has practically demonstrated that the difference in amount discharged (by streams) for given rainfalls is due almost entirely to increase or decrease of evaporation owing to increased or decreased annual temperature" (p. 75); and that temperature is 'a much more potent factor than forests, topography, or the other causes usually assigned' (p. 77) to account for the variations in the discharges of streams. So thoroughly is evaporation believed to be dependent on temperature that "the (river) gaugings (representing the rainfall which does not evaporate) actually indicate the mean temperature of the water sheds more closely than we can obtain it from available temperature observations" (p. 334). It will be readily seen that the formulæ noted above, and the principles which go along with them, greatly simplify the whole question of the relation of rainfall and stream flow, and are of the greatest importance to all interests dependent on streams, or effected by them. Formulæ are deduced for calculating the proportion of rainfall which disappears by evaporation for each month, and for determining the flow of a stream for any given month, the rainfall and temperature of its basin being known.

Of immediate practical value to the citizens of the State are the detailed data concerning the streams of New Jersey. These data include the total, the average and the minimum flow of each stream of the state, the available and the utilized power, etc., etc. The data are combined in various ways with a view to making them useful in various directions.

Popular ideas to the contrary notwithstanding, statistics show that there has been a slow but steady increase in the use of water power within the State. While many small powers have been abandoned, this loss has been made more than good by the establishment of larger ones. The total amount now in use is about 31,000 horse power. Pertinent suggestions are offered as to the further utilization of the power afforded by the streams.

Forests are thought not to influence the annual evaporation or stream flow to any marked extent, nor to influence particularly extreme floods. With deforesting, however, comes increased irregularity of stream flow, including more frequent moderate floods, lower flow of streams during periods of drought, and more protracted periods of low flow (page 344). Care is taken to emphasize the beneficial effects of forests in preserving soil on slopes, in creating absorbent matter (humus, etc.), which holds the water and helps to equalize its flow.

Cultivation is thought not to greatly affect the total stream flow, though it affects its regularity. It increases the absorbent capacity of the soil, and so the total flow from underground water, while under drainage tends to produce irregularity of flow. "As between cultivated and barren water-

sheds, * * the cultivated will show the steadiest conditions and the best-sustained dry-season flows, but as between cultivated and forested water sheds the forested will produce the best results. * * It follows also that floods will be most severe upon barren areas." Hence there exists * * 'the urgent necessity of preserving forests upon slopes, and all areas which are not adapted to agriculture' (p. 348).

Enough has been said to indicate the scope of the volume; which can hardly fail to become a hand-book on the question of water supply. It is probably not too much to say that this report alone is worth more to the State of New Jersey than its geological survey has ever cost. Other States of dense population would do well to follow the example of New Jersey, not only in studying their water resources, but in putting the work under the direction of their geological surveys; for the relation between the geology of a region and the availability of its water supply is so intimate that no other organization is better qualified to direct the work. The U. S. Geological Survey has work of this sort in progress in some parts of the semi-arid regions of the West, from which good results are sure to come.

Rollin D. Salisbury.

University of Chicago.

John Dalton and the Rise of Modern Chemistry. By Sir Henry E. Roscoe. New York and London, Macmillan & Co. 8vo. Pp. 216. Price, $1.25.

It is one of the greatest achievements of modern chemistry to have shown that for each chemical element there is a measurable quantity which, throughout all the transformations that the element undergoes, remains unchanged, and is, therefore, to be regarded as a constant. The laws of definite, multiple and reciprocal proportions of gas volumes and of specific heats, of mass action and of the periodicity of properties, all give converging evidence that for each element there is a definite constant quantity which, in all the changes that the element undergoes, acts like a unit. This constant is the one unchanging, and, therefore, the most characteristic property of the element. The chemical and physical properties of an element, its behavior under different conditions, its possibility of undergoing change under given circumstances, in short its whole character, is dependent upon the magnitude of this constant. A large part of theoretical chemistry is taken up with a consideration of the general methods that are available for the determination of this important quantity, and it is customary to express it by means of a number which indicates its magnitude in terms of the characteristic quantity of some one element, usually hydrogen, taken as a unit. To this number the name Atomic Weight has been given, and to John Dalton, indisputably, belongs the great credit of having first introduced into chemistry the idea of atomic weights. He transformed the Newtonian corpuscular theory of the constitution of bodies into a workable chemical hypothesis, and the subsequent development of his idea, that the atoms of different elements have different constant masses, has given us our present system of atomic weights. But, whether we associate with this term the conception of an atomic constitution of matter or not, the fact remains that these constants stand to-day independent of any hypothesis, and are to be regarded as mathematical quantities that can be deduced from the general laws and principles of the science.

In this book Sir Henry Roscoe has given us a most interesting account of the life and work of the great Manchester chemist. Dalton's life, like that of many scientific workers, was not an eventful one, but he was a man of marked personality, of positive traits of character, and our author has

interwoven a description of the personal characteristics of the man with an account of his scientific work and the incidents of his life in such a way as to make a most attractive and entertaining biography.

From his early years Dalton was accustomed to looking at things from the standpoint of the atomic theory, and throughout his life he remained a firm supporter of this doctrine. Like Newton, he conceived of atoms as 'hard impenetrable, movable particles,' 'incomparably harder than any porous bodies compounded of them, even so very hard as never to wear or break in pieces.' These atoms were supposed to be surrounded with an atmosphere of heat. He has left some drawings which show how he pictured to his mind the structure of the smallest particles of compounds, and in these he foreshadowed the modern constitutional and stereo-chemical formulas. In gases and elastic fluids he considered matter to be in an extreme state of division, and nearly all of his important discoveries resulted from experiments upon gases. It was by considering the constitution of gases that he came to the idea of atomic weights.

Dalton was not as skillful an experimenter as some of his contemporaries; most of his apparatus was made by himself and was often of a very primitive kind. It is remarkable that he should have been able to get the results with it that he did; results that were in most cases confirmed by other workers who used more accurate instruments and more exact methods. Some of the important facts that he discovered were the equal expansibility of different gases under the influence of heat; the practical constancy of the composition of the air, a fact which he established by means of a large number of analyses of air collected at different places and at different altitudes; the law of partial pressures, or that the total pressure of a gas mixture is equal to the sum of the partial pressures of the components, and that in a mixture of gases each component acts like a vacuum to the other components and behaves as though it alone were present. He also investigated the solubility of gases in liquids; but his greatest discovery was the law of multiple proportions. Upon this discovery and upon the fact that he introduced the atomic theory with the idea of atoms of different weights his great fame as a scientific man rests.

Of especial interest in this book is the account here published for the first time of how Dalton arrived at his important conclusion. Among the Dalton papers belonging to the Manchester Literary and Philosophicial Society, Sir Henry Roscoe has found some manuscript notes prepared by Dalton for a course of lectures that he delivered at the Royal Institution in the winter of 1809–10. These notes are printed in full and give an account by Dalton himself how his ideas regarding the atomic theory came to him.

Mentally he was vigorous, independent and self-reliant; he gave little attention to the results obtained by others. Like Newton he reached his conclusions by quiet, steady, continuous thinking. His long life was spent in experimenting and reflecting. It is pleasant to know that in his later years many honors and tokens of esteem came to him from his countrymen and from abroad.

After Dalton the atomic theory was developed and put upon a much broader foundation by Berzelius, and through his work and that of a long line of illustrious successors it has become the central dominant feature of theoretical chemistry.

It is noteworthy that Joule, who did so much to establish the law of the conservation of energy, was a pupil of Dalton, and that the names of both master and pupil are so intimately associated with our two great intellectual instruments of investigating nature, the atomic hypothesis and the theory of energy. The deductions of the

former have the advantage of being readily apprehended, those of the latter of being mathematically exact.

Sir Henry Roscoe deserves the thanks of all workers in chemistry for having provided them with an unusually interesting biography of one of the founders of the science.

Edward H. Keiser.

Bryn Mawr College.

Elasticität und Festigkeit. By C. Bach, Professor in the Technical High School at Stuttgart. Second Edition. Berlin, Julius Springer. 1894. Octavo, 432 pages and xiv plates.

In this work the author lays down the guiding principle that the student of mechanics of materials should first of all become acquainted with the actual phenomena of stress. To this end photographic illustrations are given exhibiting the deformations of bars under tension, of blocks under compression, of beams and plates under flexure and of shafts under torsion. These illustrations are most useful and show the typical changes of form in a beautiful manner. Nevertheless their value is probably not so great as the author assumes, for nearly all the theories and computations of the mechanics of materials are confined to the case where the elastic strength is not exceeded and where changes of form are not perceptible to the eye.

The modulus or coefficient of elasticity, usually represented by the letter E, is not employed in this book. Instead its reciprocal is used and called the extension coefficent, which may be defined as the stretch of a bar per unit of length due to a stress of unity on each square unit of cross section. There can be no doubt but that the term coefficient of elasticity is a most unfortunate one, as it has no relation to elasticity in the ordinary sense of the word, but is a measure of stiffness or rigidity. The improvement desired would be a change of name rather than the introduction of a new term and symbol. Even the author, who uses the new constant consistently in all his formulas, rarely gives numerical values for it, but expresses these in terms of its reciprocal, which is, of course, the coefficient of elasticity as universally employed.

The scope of the work is that of a textbook on the mechanics of materials and of beams, columns and shafts, suitable for technical schools which desire to avoid extended mathematical discussions. The usual theoretic formulas are demonstrated in a neat manner, and many results of tests are presented; those on circular, elliptical and rectangular plates may in particular be noted as novel and valuable. The subject of internal work or resilience is discussed more fully than in British or American books. True internal stresses resulting from the change of shape are properly used in the treatment of cylinders, spheres and plates; owing to the neglect of this precaution, formulas based upon apparent stresses, like those of Rankine, are liable to give values often deviating twenty-five per cent. from the truth.

The formula for the design of columns, long used in the United States under the name of Gordon's formula or Rankine's formula, has not been employed in Germany to the extent that its value demands. The author, however, emphasizes it as an important rule, and gives empirical constants for its use. He also states that the formula was first deduced by Navier; on referring to Navier's works this statement is not found to be justified, it being only mentioned that the stress on the concave side of the column is the sum of the stresses due to direct compression and to lateral flexure, while no formula similar to Gordon's is established.

On the whole, the perusal of the book leaves the impression that the author has

done his work with much painstaking care, and that both the theoretical and the practical part are set forth in a manner which cannot fail to give students an excellent foundation in the science of the elasticity and strength of materials.

MANSFIELD MERRIMAN.

LEHIGH UNIVERSITY.

The Pocket Gophers of the United States. Bulletin No. 5, U. S. Department of Agriculture, Division of Ornithology and Mammalogy. Prepared under the direction of DR. C. HART MERRIAM, Chief of division, by VERNON BAILEY, Chief Field Agent, Central Park, New York. Published by authority of the Secretary of Agriculture. Washington, Government Printing Office. 1895. 8vo., pp. 47. Frontispiece, 6 cuts in the text, and colored map.

In a former number of SCIENCE (N. S. Vol. I., No. 9, March 1, 1895) attention was called to a monograph by Dr. Merriam on the Pocket Gophers (family Geomyidæ), in which was presented the scientific results of his extended aud detailed studies of the group. The present 'Bulletin' is a fitting sequel to the technical monograph already noticed, dealing, as it does, with the economic relations to agriculture of these destructive rodents. This paper was prepared by Mr. Vernon Bailey, under the direction of Dr. Merriam, Chief of the Division of Ornithology and Mammalogy of the U. S. Department of Agriculture. Mr. Bailey is one of the most experienced and expert of the many expert field naturalists now connected with this branch of government service, and is therefore eminently fitted by personal experience in the field for the preparation of a report like the one under notice.

The first ten pages relate to the general habits of these animals, which live almost wholly under ground, and make known their presence chiefly by the mounds of earth thrown out from their burrows, or by their troublesome depredations upon farm and garden products. Even where so numerous as to be exceedingly troublesome they are rarely seen, and little is known of their life habits by even the people who suffer from their depredations. Hence the detailed account of their habits and methods of working here given is a welcome contribution toward a fuller knowledge of their life histories. Although deficient in vision, their senses of taste, touch and smell seem to be compensatingly acute, and their ample external cheek-pouches serve an important function in the transportation of food, for which they seem exclusively used. The Gophers, says Mr. Bailey, "are industrious workers, and whatever food is found and not needed at once is carried to chambers in some part of the tunnel and stored. * * * Sometimes a peck of small potatoes, roots of coco grass, wild parsnip, wild sunflower and other fleshy or bulbous roots are found in a single chamber." They are especially fond of potatoes, turnips, carrots, beets, onions, parsnips, corn, barley, rye and alfalfa, and even squashes and melons do not escape their ravages. They are also very destructive to fruit and ornamental trees by eating off their roots, which are sometimes so thoroughly cut away that the trees fall from lack of support. Their burrows are also often a source of injury over comparatively large areas, through the large amount of earth thrown up as mounds, thus burying crops, and sometimes they cause breaks in irrigating ditches and induce serious washing of hillside lands.

The Gophers have few natural enemies, and seem to flourish and increase through the fruits of man's industry. Hence the question of artificial means of destruction becomes a matter for careful consideration. They can be trapped readily by those who know how to do it, but generally the art is unknown, and it is a widespread belief

among farmers subject to their inroads that they cannot be caught in traps. Mr. Bailey especially commends the use of bisulphide of carbon for their destruction, which is readily accomplished by placing an ounce or two of this volatile fluid on cotton or rags in their burrows. Instructions are also given for the use of poison and traps. In consequence of the harm done by Gophers, bounties have been offered in many parts of the West, but the system is condemned as a means of depleting the county treasuries without effecting the extirpation of the Gophers. Thus it is stated that Benton county, Iowa, paid out $18,000 in three years in Gopher bounties, "but the Gophers, though greatly reduced in numbers, were not exterminated."

Gophers of one species or another occupy practically the whole of the United States west of the Mississippi River, and also the greater parts of the States of Illinois, Georgia, Alabama and Florida. Detailed accounts are given of the habits of the various species found east of the Rocky Mountains. Aside from its important economic bearings, the Gopher Bulletin is a most interesting contribution to the life history of a group of animals hitherto little known. Four of the six illustrations in the text are from Dr. Merriam's monograph, as are the frontispiece (Georgia Gopher), and the colored map of the distribution of the species of the genera *Geomys* and *Craterogeomys*. The two colored plates (of the Prairie Gopher and Gray Gopher), called for in the list of illustrations, and prepared especially for this Bulletin, are lacking, in consequence, as we are privately informed, of their having been 'mislaid' at the Government Printing Office after their production and delivery by the Department of Agriculture.

J. A. Allen.

[*The Norway Lemming*] *Myodes lemmus, its Habits and Migrations in Norway*, by R. Collett. Christiania. 1895. 8°. pp. 62.

The distinguished naturalist of Christiania, Dr. R. Collett, has just published a treatise on the Norwegian Lemming that at once becomes a classic on the subject. He tells us that, in a manuscript believed to have been written in the latter half of the 13th century, the Lemmings are supposed to have been the same as the 'locusts' mentioned in the Bible in connection with the plagues in Egypt. In a book published by Jacob Ziegler in 1532 the theory of their descent from the clouds is proposed, based on statements of two bishops from Trondhjem. In 1555 Olaus Magnus, Archbishop of Upsala, published a figure showing the Lemmings (with tails like house mice) falling from the clouds and being preyed upon by Ermines.

Dr. Collet states that normally the Lemming inhabits all of the mountain plateaus of Norway above the zone of coniferous trees, descending in Finmark to sea level, thus occupying about one-third of the total land area. Besides the mainland they inhabit the large rocky islands off the coast, especially to the northward.

In normal years they are rarely seen, even by explorers. In prolific years they suddenly increase and overflow vast areas. In such years according to Dr. Collet, "The litters produced during the course of the summer follow so closely one upon the other that the one set is barely allowed time to leave the nest ere the next lot arrives. Futhermore, the litters are unusually large, as they constantly contain up to 10 younglings in each set (although possibly 6 or 7 on the whole is the rule); and all these young ones appear to be possessed of greater powers of attaining maturity than those produced during a normal year."

This excessive reproduction results in overcrowding the breeding grounds, from which vast numbers move away in different directions. Descending the mountains and following the valleys they continue blindly

on, proceeding hopelessly to certain death. The direction of the march is dependent on the valleys, and the exodus may "radiate in quite opposite directions from one and the same mountain plateau. * * * * Thus during migratory years the southern ramifications of the Lang Fjeld will emit swarms which may advance eastward as far as the Christiania Fjord; southward, down to the coastal regions of Christiania Stift; and westward, to the fjords in the counties of Stavanger and Söndre Bergenhus. * * * During the entire course of the summer and autumn, they continue to pour forth from the mountains. * * * * In the valleys they invariably meet with lakes or rivers, and large numbers constantly endeavor to cross them. If the mountains are high on both sides, the valley will, as a rule, receive contributions from each slope, and individuals may be observed crossing the river in both directions."

"During the migrations they do not allow themselves to be stopped by rivers, or even by the arms of a fjord, but trust themselves, without hesitation, to the mercy of the waves, in order to reach the opposite shore. It would almost seem as if no stretch of water were too wide for them to cross if they but see land on the other side. During the great migration in the district of Trondhjem in 1868, which has previously been mentioned, a steamer on the Trondhjem Fjord steamed into a crowd of swimming Lemmings of such vast extent that she took over a quarter of an hour to pass through it, and as far as one could see from the vessel down the fjord its waters were covered everywhere with these animals. During the great migratory years similar accounts are received from all the great lakes (Mjösen, Randsfjord, Kröderen, etc., etc.)."

Great havoc is wrought in meadows and grain fields by the hungry hordes, particularly in mountain pastures and farms situated on the higher slopes.

It is stated that no rule can be laid down concerning the frequency of the migratory years. The greatest migrations, which extend down to the most distant lowlands, take place but seldom and rarely occur in the southern districts oftener than once in ten years. The number Dr. Collett has collected data for is surprising. He gives the dates and areas invaded for seven great migrations from 1739 to 1790, and for no less than 24 in the present century.

As to the extent of the areas invaded, Dr. Collett says: "On the whole it may be assumed that scarcely any accessible point of Norway (except the outermost islets) has not been invaded by their hordes during one or other prolific year."

"It has hardly ever happened that a prolific year (and the consequent migration) has simultaneously embraced the entire land. The rule is that the increase takes place in great or small districts independent of each other, but the area which may be involved thereby may be of very considerable extent. Occasionally the increase will take place simultaneously in two separate districts, divided from each other by an area of greater or lesser extent, in which the production is normal. In Norway there may be recognized, on the whole, at least five great groups of mountains within which most of the migrations have their radiating centre. One migration may embrace either the entire group or small portions of it."

The regular enemies of the Lemming are numerous and many of them increase with the Lemmings; as the birds of prey, the large gulls and skuas, and weasels and foxes. In prolific years certain birds which follow the Lemmings change their breeding grounds and nest in localities where they are never seen at other times. To these may be added certain irregular enemies; for Dr. Collett tells us that reindeer (both wild and domesticated), cows, goats and pigs kill and eat them in great numbers.

But the destruction of the Lemmings after reaching the lowlands is only in small part due to these enemies. "The most active factor in their extermination," says Dr. Collett, "appears to be infectious diseases, which invariably occur whenever a species of animal has multiplied in excess of its natural numbers."

Not only do the Lemmings themselves die of disease; but they are believed to cause serious disease among the human population. This belief has been current in Norway from time immemorial and was published by Ziegler more than 350 years ago. Dr. Collett states that during Lemming years all running water is contaminated by the decaying excrement. "To this may be added the dead animals, which will be found lying scattered about in great numbers, and which, during hot summers, become quickly decomposed. The rain carries the putrid matter on to the nearest watercourse, whence it makes its way to wells, and becomes mixed with the drinking water of the inhabitants.

"During some great prolific years, definite forms of sickness have appeared in certain of the overrun districts, and the people have given these the name of 'Lemming Fever,' as they presumed that they were connected with the appearance of these animals."

After citing medical testimony and describing the disease, Dr. Collett concludes: "Lemming fever is thus a disease which, in its phenomena, is related to scarlet fever. Its origin is regarded, both by medical men and the populace, as having a certain connection with the appearance of the swarms of Lemmings and the pollution of water by their putrifying carcasses and dung during dry summers."

Dr. Collett's treatise on the *Habits and Migrations of the Lemming in Norway* is replete with interest from beginning to end and must long remain the standard authority on the subject. C. H. M.

NOTES AND NEWS.

ASTRONOMY.

The London *Times* gives the following accounts of recent lectures before the Royal Institution and of the last meeting of the British Astronomical Association:

Dr. W. Huggins, F. R. S., gave the second of his course of lectures on the instruments and methods of spectroscopic astronomy, at the Royal Institution, on May 30th. He dealt with the more complex instrument which is placed at the eye-end of the telescope so that the images of the stars fall upon its slit. The important question of its efficiency was connected, the lecturer said, with its power to break up the spectrum into as many parts as possible. This power of separation was fixed by certain conditions—the linear length of the spectrum, its dispersion, and the resolving power of the prism. The latter, which was independent of dispensive power, was governed by the size of the prism, hence larger prisms have greater resolving power. But the use of larger prisms in astronomical work entailed certain disadvantages, such as increased weight and cost, and difficulty of obtaining glass of uniform quality. It was therefore fortunately possible to get the results of large prisms by passing the beam through several smaller ones, though the loss of light by absorption and reflection from the faces of the prisms was very serious. An alternative way of obtaining a spectrum was to use a diffraction grating, which we owed to the experiments Fraunhofer made to discover whether the lines of the spectrum were due to interference of light. His original gratings were made by winding wire in a screw-thread round a piece of glass; ultimately he adopted the plan of ruling the lines on glass with a diamond point. Great advances were made by Rutherfurd, whose machine cut lines to the number of 17,000 to an inch, and by Rowland. There is, however, but little to choose

between a prism and a grating with 14,000 lines to the inch.

THE Friday evening discourse at the Royal Institution on May 31st was given by the Earl of Rosse, who took as his subject the 'Radiant Heat from the Moon during the progress of an Eclipse.' Sir Frederick Abel was in the chair, and among those present were Lord Kelvin, Sir James Crichton-Browne, Sir Frederick Bramwell, Professor Dewar, Mr. C. V. Boys, Dr. Frankland, Mr. Ludwig Mond and Mr. Crookes. Lord Rosse began by showing the results of his observations on the variations in the amount of heat radiation from the moon during the lunar month. Speaking of the heat given off during an eclipse, he said that in the total eclipse of January, 1888, he had found there was a great decrease in its amount some time before the first contact. During the total phase the heat radiated was a mere trifle, and it had not regained more than 80 per cent. at full moon —an hour and a half after the last contact. Lord Rosse then described the apparatus he had used, and also the apparatus and some of the results of other investigators.

THE usual monthly meeting of the British Astronomical Association was held at University College on May 28th, Mr. E. W. Maunder, the president, being in the chair. A paper was read from Professor H. H. Turner, Savilian Professor of Astronomy at Oxford, on 'Simple Apparatus for Measuring Stellar Photographs.' Mr. Holmes read a paper on on 'The Reproductions of Astronomical Drawings,' etc., in which the value of photographic processes was commented on as being more accurate. He also read a paper on the apparent roundness of small spot markings on planets. A paper from Mr. Monck on the 'Spectra and Colours of Stars' was read. The report of the Lunar Section, by Mr. T. Gwyn Elger, F. R. A. S., the director, was read, and attention was called to the progress made recently in lunar photography.

GENERAL.

PROFESSOR C. LLOYD MORGAN, author of *Animal Life and Intelligence* and other works upon comparative psychology, is coming to this country next winter to deliver one of the Lowell Institute courses in Boston. He will also deliver four lectures upon Instinct in the Columbia Biological Course.

FIELD exploration in vertebrate palæontology is increasing very rapidly, and this summer a large number of parties will be in the field. The American Museum expedition to the Uinta Basin entered the field in March, accompanied by Mr. J. B. Hatcher, representing the Princeton Museum. On June 1st Dr. J. L. Wortman takes charge of the American Museum party, which will include four collectors. The University of Kansas will send three parties into the fossil beds of Kansas, Dakota and Wyoming. The University of Nebraska will also send a party under the direction of Prof. Barbour. Prof. Baur, of the University of Chicago, announces a field expedition as a regular part of the University curriculum.

THE Royal Academy of Sciences of the Institute of Bologna offers a gold medal of the value of 1,000 francs for a memoir which either from the chemical, physical or mechanical point of view will indicate a practical system or new apparatus for the prevention or extinction of fire. The essays may be written in Italian, French or Latin. Those in other languages must be accompanied by an Italian translation. The essays are to be signed with a *nom de plume* and to be accompanied by an envelope containing the author's real name. All essays must be in before May 29, 1896, and should be addressed: "*Al Segretario della R. Academia delle Scienze dell' Instituto di Bologna.*"

The Trustees of the British Museum have issued a Catalogue of Additions to the Manuscripts in the years 1888–1893. The catalogue is provided with a serviceable index. They have also published a translation of the Papyrus of Ani which contains the most complete text of the famous Egyptian Book of the Dead. The translation, which is accompanied by a valuable introduction, is from the pen of Mr. E. A. Wallis Budge.

Another Egyptian publication of importance is from the press of Brill, at Leiden, and contains fac similes and descriptions of a papyrus (F. T. 71 So-am-tra) devoted to mortuary customs.

Mr. M. A. Mackenzie, of Trinity University, Toronto, has been appointed professor of mathematics in place of the Rev. Dr. Jones, who has accepted the position of bursar in the same institution.

Professor Frankland has been elected a foreign associate of the *Académie des Sciences*. The vacancy was caused by the death of M. van Beneden.

Applications for the position of lecturer in Chemistry in the university of Toronto should be sent to the Canadian Minister of Education before August 15th. The initial salary will be $1,000, increasing by annual increments of $100 until it reaches $1,800. The duties of the lecturer will be to assist the demonstrator in the superintendence of the laboratories under the direction of the professor of chemistry, and also to deliver such lectures on physiological, organic and inorganic chemistry as may be assigned to him by the professor.

The Lancet announces the following foreign medical appointments: At Erlangen—Dr. G. Hauser has been promoted to the chair of general and anatomical pathology, vacant by the retirement of Dr. von Zenker. At Gratz—Drs. Drasch and Jarisch have been promoted to professorships of histology and dermatology, respectively. At Oporto—Dr. I. do Valle, Professor of General Pathology, has been appointed to succeed Dr. Carlos Lopez in the chair of materia medica, Dr. Maximiano de Lemos taking the chair of general pathology.

At Berlin, Dr. Ferdinand Karsch and Dr. Anton Reichenow have been made professors in the Zoölogical Museum, Dr. Victor Kremser in the Meteorological Institute, and Dr. A. Börsch in the Geodetic Institute.

At the anniversary meeting of the Royal Geographical Society of London, Mr. Clements R. Markham was elected President for 1895–6. Mr. W. T. Blanford, the Hon. G. C. Brodrick, the Hon. George Curzon, Sir George Taubman Goldie, General R. Strachy and Rear-Admiral W. J. L. Wharton were elected Vice-Presidents.

Daniel Kirkwood, professor of mathematics in Indiana State University, died at Riverside, Cal., on June 11th, at the age of eighty-one. He retired from the active duties of the professorship in 1856.

The chair of physics in the University of California, recently filled by the late Professor Harold Whiting, has been offered to Mr. Exum Percival Lewis, Ph. D., of Johns Hopkins University.

At a meeting of the Royal Botanical Society on May 31st Professor George Henslow delivered a lecture on 'A Century of Progress in Floriculture.' He exibited specimens of the original wild plants from which some of our most admired garden flowers have been developed, illustrating with numerous diagrams the various stages in the way of cultivation and hybridization through which they passed before reaching the perfection of to-day.

Flood & Vincent (Chautauqua Press), of Meadville, Penna., announce the appearance of 'Thinking, Feeling, Doing,' a popular exposition of experimental psychology

by E. W. Scripture, of Yale University. The book contains one colored plate and over 200 illustrations; it has a voluminous index.

ACCORDING to the *Evening Post* Professor Fabian Franklin has resigned his Professorship of Mathematics in Johns Hopkins University in order to become editor of the *Baltimore Evening News*.

THE American Medical College Association in Baltimore has decided by a vote of of 29 to 5 that a four years' course of study shall be demanded of all students henceforth matriculating in institutions belonging to this organization.

AT the graduating exercises of Johns Hopkins University on June 13th the degree of Ph. D. was conferred on 46 candidates, distributed among the different departments as follows: History and economics 12, chemistry 12, geology 3, German 2, English 3, physics 4, Romance 3, Latin and Greek 5, biology, mathematics and astronomy, each 1.

BARNARD COLLEGE has purchased for $160,000 a site on Cathedral Heights, adjacent to that of Columbia College. The sum of $200,000 has been subscribed towards the new buildings.

ON January 18th the great seismometrograph at the Osservatorio del Collegio Romano at Rome registered five complete pulsations of slow period characteristic of earthquakes originating at a great distance. They commenced at 4h. 37m. 30s. p. m. (Greenwich mean time), and lasted 1m. 22s., giving an average duration of 16.4 seconds for each pulsation. On the same day a severe earthquake was felt along the east coast of Japan, and was recorded at Tokio at 3h. 48m. 24s. The distance between this place and Rome being about 9,500 km., the pulsations must have traveled with an average velocity of 3.2 km. per second (see *Nature*, vol. l, pp. 450–51; vol. li., p. 462). At Nicolaiew and Charkow, in the south of Russia, the horizontal pendulums were disturbed for nearly an hour, the epoch of maximum amplitude occurring a few minutes earlier than at Rome.—*Nature*.

MESSRS. MACMILLAN & Co. will shortly publish an *Introduction to the Study of Seaweeds*, with illustrations, by Mr. George Murray, the newly appointed Keeper of Botany in the Natural History Department of the British Museum.

IT is announced that Professor Albert S. Bickmore, of the Museum of Natural History, New York, will deliver the address at the laying of the corner-stone of Butterfield Museum, Dartmouth College. It is hoped that the museum, which will cost about $60,000, will be ready for occupancy in the latter part of 1896.

ARRANGEMENTS for an accurate map of Africa will be made at the International Geographical Congress which is about to meet in London. It is expected that Great Britian, France, Germany, Belgium, Italy and Portugal, being the powers chiefly interested, will divide the expenses of the map.

THE Naturalists' Directory published by S. E. Cassino, Boston, for 1895, contains the names of 5,747 naturalists of the United States and Canada arranged in alphabetical order, giving under each name the specialty studied and the address. The names are also arranged by subjects and geographically by States. The directory contains 382 pages, and is neatly bound in cloth. The price is $2.50.

THE following appointments have been made in Cornell University: Virgil Snyder Ph. D. (Göttingen) has been appointed instructer in mathematics; Darwin A. Mortant, assistant in chemistry; W. K. Hatt (assistant professor at Purdue University) and John Hayfold, instructors in civil engineering; Elias J. Durand, assistant in

cryptogamic botany, and H. H. Denham, instructor in chemistry.

The Cambridge Scientific Instrument Company (Limited) has been formed with a capital of £10,000, in £5 shares. Its objects are to acquire the business carried on at Cambridge by Mr. Horace Darwin as 'The Cambridge Scientific Instrument Company,' and to adopt an agreement for the purpose, and to carry on the business of mechanical and electrical engineers, and scientific instrument and apparatus manufacturers. The first directors are Mr. Horace Darwin (chairman and managing director), Major Leonard Darwin, Mr. Hugh F. Newall and Mr. William N. Shaw. The remuneration of the directors will be fixed by the company.

Dr. Albert Mann has been appointed professor of biology in Ohio Wesleyan University.

In Syracuse University Dr. E. C. Quereau has been appointed professor of geology and mineralogy, and Dr. W. H. Metzler associate professor of mathematics.

Dr. W. L. Abbott has sent to the U. S. National Museum the collections made during his travels in Pamir, Central Asia. Among these are the skins of 228 birds and more than 100 mammals, many of which are said to be new to science.

An editorial article in *Garden and Forest* for May 29th contains on appeal for a fitting memorial to Andrew Jackson Downing. From it we may quote the following facts:

"Mr. Downing was an authoritative writer on the art of landscape-gardening. His treatise on the *Theory and Practice of Landscape-Gardening*, published in 1841, became at once the accepted text-book of the subject. In 1849 he wrote a series of articles in *The Horticulturalist* on public parks which had a marked influence in creating and molding public sentiment in this direction. The actual work of constructing Central Park was not begun until six years after Downing's untimely death, but it was his stirring appeals that aroused the city to feel its need, and provision to meet it quickly followed. It is not too much to say that Downing takes rank among the greatest benefactors to his country which this century has produced. It is now more than forty years since his death, and it is surely time that some memorial of him should be erected in the park which his genius secured for the city of New York."

The last number Vol. VII., No. 4, of the Journal of the College of Science of the Imperial University of Japan bears witness, as the preceding numbers have done, to the aptitudes of the Japanese for exact research. The number contains eight short contributions to chemistry and an account of the earthquake of June 20th, 1894. This was the most violent earthquake that has occurred in Tokyo since 1855.

A work on electricity and magnetism by Professor Francis E. Nipher, Washington University, St. Louis, will be published during the summer.

The State Agricultural College at Corvallis, Ore., has begun the publication of a series of laboratory studies in zoölogy edited by Prof. F. L. Washburn.

The paper on the Proto-historic Ethnography of Western Asia, read by Dr. D. G. Brinton before the American Philosophical Society on April 19th, has been reprinted from the Proceedings of the American Philosophical Society and is published by MacCalla & Co., Philadelphia.

Dr. J. Dörfler, I. Burgring 7, Vienna, is compiling a *Directory of Living Botanists*, together with botanical gardens, societies, journals, etc. The coöperation of botanists throughout the world is requested.

At the annual meeting of the Linnaean Society, held on May 24th, the gold medal founded in 1888 on the occasion of the cen-

tenary of the Society, and awarded alternately to a biologist and zoölogist, was presented to Dr. Ferdinand Cohn, professor of botany in Breslau. Last year the medal was awarded to Professor Haeckel, of Jena, in recognition of his researches in the science of marine invertebrate zoölogy.

THE third International Congress of Physiology will meet in Berne from Sept. 9th to Sept. 13th, 1895.

ACCORDING to the *Revue Scientifique* M. Tocchini, the director of the Central Bureau of Meteorology in Rome, has founded a Seismological Society, having for its object the study of earthquakes and volcanic phenomena, and the publication of short accounts of the results obtained and of the apparatus used.

The *Revue Scientifique* also reports the formation of an Astronomical Society in Bruxelles, with the object of bringing into closer communication all those interested in astronomy and related sciences.

Two hundred unprinted letters of Pestalozzi have been found in Switzerland. They will be published by Seyffarth, whose biography of Pestalozzi has already reached its sixth edition.—*N. Y. Evening Post.*

HENRY PHILIPS, JR., died in Philadelphia on June 6th, at the age of 57. Mr. Philips was well known as an archæologist, numismatist and philologist.

THE University of Glasgow has received an anonymous gift of £10,000 for the purpose of founding a chair of political economy to be named after Adam Smith, who was once professor in the University.

THE honorary degree of Doctor of Science has been conferred by the University of Cambridge on Dr. John Murray, editor of the 'Challenger' publications.

THE following recent appointments to assistant professorships are announced from Johns Hopkins University: Dr. Charles Lane Poor, astromony; Dr. Sidney Sherwood, political economy; Dr. Alexander S. Chessin, mathematics and mechanics; Dr. John M. Vincent, history; Dr. Simon Flexner, Pathology. Dr. Edward B. Matthews and Herbert G. Geer have been appointed associates in mineralogy and mechanical engineering respectively.

AN International Horticultural Congress was opened at Paris on May 24th.

THE *Institut* of France has opened an international subscription for a moument to Lavoisier, to be erected in Paris.

MR. RALPH SWINBURNE, said to have been the oldest engineer in the country, died recently, aged ninety years.

MR. L. L. PRICE'S paper on 'The Colleges of Oxford and Agricultural Depression' contains, according to the *Academy*, "a detailed analysis of the expenditure of the colleges in 1883 and 1893. During this period the amount received by the heads (excluding Christ Church) has fallen from £22,811 to £20,905, or by more than 8 per cent.; in some cases, of course, the decrease is much more, while in a few there is an increase. The amount received by fellows (apparently including professor-fellows) has fallen from £70,980 to £59,715, or by more than 15 per cent. Here, again, there are wide variations, though only two examples of actual increase. In the case of one college, which shall be nameless, eight fellows in 1893 had only £400 to divide among them. On the other hand, the amount appropriated to scholarships and exhibitions has risen during the same period from £44-776 to £48,378, or by nearly 10 per cent. In hardly any case is there a decline; while at the unnamed college referred to above the scholars now receive nearly four times as much as the fellows. The number of scholars and exhibitors has risen from 570 to 658, while the number of fellows seems to have remained stationary. In addition, the colleges in 1893 paid over an assess-

ment of £4,334 to the common university fund, a heading which practically did not exist in 1883; while during these ten years contributions to the salaries of the professoriate have increased from £12,840 to £15,034. It seems pretty clear that the results of agricultural depression have fallen almost solely upon the fellows, and upon some of them hardly."

Professor Bunsen celebrated his eighty-fifth birthday on March 31st.

At the last meeting of the Geological Society, Prof. Judd drew attention to an interesting series of photographs sent for exhibition by Prof. Liversidge, of Sydney, who has found that sections of gold nuggets, when etched with chlorine-water, exhibit lines like the Widman-Stetten figures of meteorites, showing that the gold has a crystalline structure, octahedral and cubic forms being displayed.—*The Academy.*

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON.

At the meeting held May 18th Dr. Merriam spoke of the Mammals of the Pribilof Islands in Bering Sea. Excluding Cetaceans, eight mammals are known from the Islands. Four of these are land mammals and four amphibious or marine, as follows: One, Arctic fox; two, brown lemming; three, shrew; four, house mouse; five, harbor seal; six, fur seal; seven, sea-lion; eight, walrus. To these the sea-otter might be added, though it is not a resident and visits the islands very rarely. The house mouse was introduced by the Russians and has run wild. The fox also is said to have been introduced. The shrew has been found on St. Paul only; the lemming on St. George only.

A paper entitled 'The Hares (genus *Lepus*) of the Mexican Border' was read by Dr. Edgar A. Mearns, who stated that it was written in the course of preparation of a report on the collections made by the biological section of the recent re-survey of the Mexican boundary line, of which expedition Dr. Mearns was the surgeon and naturalist from January, 1892, to September, 1894, with one intermission of a few months. The doctor's field experience in that general region covers in all a period of seven years. The specimens of *Lepus* accumulated during that time amount to 288, representing 15 species and subspecies, to which material were added the collections of the United States National Museum and a portion of those of the American Museum of Natural History in New York, making a total of about 400 specimens examined. The species of the Mexican border were shown to represent three sections of the genus *Lepus*, which might with advantage be recognized as subgenera. These were Hydrolagus Gray (Water Hares, represented by a single species, *Lepus aquaticus* Bachman); Sylvilagus Gray (comprising (1) the Cottontails, 3 species and 3 additional subspecies, and (2) the Cactus Hare, *Lepus cinerascens* Allen); and Macrotolagus (a new subgenus created for the Mexican group of Jackrabbits, of which 6 species and 3 additional subspecies were found on the Mexican border). In all, 17 forms were recognized as occurring on the strip of the United States which borders on Mexico, of which number seven were treated as subspecies and the remainder as species, of which latter there are eleven, *Lepus sylvaticus* being represented by (3) subspecies. Two species and four subspecies were described as new. Of these, Holzner's Cottontail inhabits wooded mountains from New Mexico and Arizona southward, and the Lesser Desert Cottontail the region from the upper Rio Grande of Texas westward to the continental divide. The black-naped Jackrabbit of the Lower Rio Grande was named in honor of Dr. C. Hart Merriam; and another species of Jackrabbit from the

plains east of the continental divide was dedicated to Lieutenant D. D. Gaillard, U. S. A., a member of the International Boundary Commission. The Gray Jackrabbit of the Upper Rio Grande region, and the Desert Jackrabbit of the Colorado Desert, were described as superficially distinct from the *Lepus texianus* Waterhouse. The Mexican Jackrabbit (*Lepus callotis* Wagler), with which several species inhabiting the United States have hitherto been confounded, was shown, principally on the authority of Dr. C. Hart Merriam, as the result of explorations lately conducted in Mexico by his Division of the U. S. Department of Agriculture, to be wholly extralimital to the United States, and not to occur near our southern border.

Diagnoses of the new Hares discovered by Dr. Mearns will soon appear in the proceedings of the U. S. National Museum, the complete article to form a part of the biological report of the International Boundary Commission.

Dr. Erwin F. Smith read a paper on *The Biology of Bacillus tracheiphilus* n. sp., *the cause of wilt in various Cucurbits*. The organism has been isolated and numerous infections secured from pure cultures—more than fifty—in the greenhouse under strict control. The disease has also been induced by spraying the bacillus on insects (Diabrotica vittata and Coreus tristis) and turning these loose on the plants, thus confirming a belief expressed in 1893, and due to field observations, that the disease is ordinarily transmitted by leaf eating beetles and squash bugs. During the nine months in which experiments have been conducted under glass, the only cases have been those due to artificial infections, none of the numerous control plants having developed the disease. The paper described the morphology of the organism, its behavior in various media—agar, gelatine, potato and sweet potato, beef broth, vegetable infusions, milk and various saccharine fluids in fermentation tubes; resistance to heat and dry air; behavior with stains; growth in acid and alkaline media, in hydrogen; parts of plants attacked, lesions, symptoms, time of appearance after inoculation, etc. Numerous repeated inoculations into potato and tomato vines failed to induce any disease, and the positive and negative evidence are both conclusive that this disease is entirely different from the southern potato and tomato blight. Inoculations into pears and hyacinths also gave negative results. The organism used for infections was isolated from the cucumber, and most of the inoculations were performed on the cucumber and muskmelon by pricking the germs into the blade of a leaf. Experiments on pumpkins and squashes are still in progress. The prompt destruction of leaf-eating and leaf-puncturing insects appears to be the only satisfactory way of combating this disease. How this shall be done to best advantage is a problem belonging to the province of economic entomology.

An interesting paper on the *Means of Intercommunication among Wolves*, by Mr. Ernest Thompson, was read. Mr. Thompson gave first place to the sense of smell as a means of obtaining information.

M. B. WAITE,
Recording Secretary.

THE NEW JERSEY STATE MICROSCOPICAL SOCIETY.

THE Society held its 26th annual meeting on Monday, May 27th, and elected the following officers for 1895–96:

President, Byron D. Halsted, Sc. D.
Vice-President, Julius Nelson, Ph. D.
Recording Secretary, Frederick H. Blodgett.
Corresponding Secretary, John Helm, M. D.
Treasurer, A. C. Hutton, M. D.
Curator, A. H. Chester, Ph. D.
Librarian, Frederick H. Blodgett.
Trustee (two years), Fred. B. Kilmer.

The Secretary's report showed an increase in general interest on the part of the members and an increase also in the attendance of visitors at the regular meetings.

The quarter-centennial was celebrated by a well attended public meeting. The program of this meeting included the projection of micro-slides of rock sections, marine algæ, living animalculæ and wood sections, and table exhibits from the three natural kingdoms under thirty-five instruments.

About a year ago the Society was sectionalized, and the following sections created:

(1) Agriculture, (2) Bacteriology, (3) Biology (Zoölogy), (4) Botany, (5) Chemistry, (6) Entomology, (7) Geology, (8) Histology, (9) Mineralogy, (10) Pathology, (11) Physics, (12) Technique, (13) Literature.

Of these the sections on Bacteriology, Botany and Mineralogy have had charge of one meeting each, and reports of less length have been made by the sections on Technique and Literature.

The membership includes 40 active, 19 corresponding and 1 honorary member.

After the business session A. H. Chester, Ph. D., read a paper on 'Crystals,' describing the means used in the preparation of crystals for micro-mounts; slow crystallization from fusion, or solution, sublimation, precipitation and electrolysis. The paper described the systems of crystals to some extent, mentioning more especially those of gold, silver and copper. With the aid of ten microscopes the minute beauties of the crystals were shown, with appreciation to a goodly number of members and friends.

SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE, JUNE, 1895.

The June number of the American Journal of Science opens with an article by Prof. Frank Waldo discussing the daily march of the wind velocities in the United States. This is based upon the published data furnished by the Chief Signal Officer's Report for 1890, giving the average wind movement for each hour of each day in this year, and also the daily averages for the seven years 1883–89. These are discussed for the different portions of the country and the results presented in a series of curves; they show distinct maxima for many stations in January, which are still more developed in July. D. A. Kreider describes the preparation of perchloric acid and its application to the determination of potassium; also W. H. Hobbs, the crystal form of borneol and isoborneol. R. Ruedemann gives an abstract of a paper (to appear in full in the Report of the New York State Geologist) on the mode of growth and development of the graptolitic genus Diplograptus; a series of figures illustrates the subject. N. H. Darton gives an account of the recent discovery of a dike penetrating the Salina formation at DeWitt near Syracuse, N. Y.; this occurence is of especial interest because doubtless connected with the Syracuse dike described by Dr. G. H. Williams in 1887. The petrography of the DeWitt dike is fully given by J. F. Kemp. Another article is by G. M. Dawson, giving a general discussion of the amount of elevation that has taken place along the Rocky Mountain Range in British America since the close of the Cretaceous; the minimum estimate obtained of greatest uplift for the region (about latitude 50°) is 32,000 to 35,000 feet. Three analyses of sodalite are given by L. McI. Luquer and G. J. Volckening. The number closes with a series of abstracts and reviews, and finally the volume index. Under the Geological Notes, R. T. Hill mentions the discovery of a dicotyledonous flora in the Cheyenne sandstone at the base of the beds belonging to the Comanche series in Comanche and Barber counties, of southern Kansas.